Proc. *Observational Cosmology with the new Radio Surveys*, Tenerife, Spain, Jan. 13–15, 1997
eds. M. Bremer, N. Jackson & I. Pérez-Fournon, Kluwer Acad. Press, in press

RADIO-OPTICAL ORIENTATION OF E/S0 GALAXIES:

APM versus FIRST

E. A. STENGLER-LARREA
Inst. de Física de Cantabria, Av. los Castros, 39005 Santander, Spain

AND

H. ANDERNACH
Dpto. de Astronomía, IFUG, Apdo. Postal 144, Guanajuato, México

Abstract. We searched for extended radio sources in isolated E/S0 galaxies comparing the FIRST and APM catalogues for a single POSS plate. The 35 most promising candidates were visually inspected on the Digitized Sky Survey (DSS) and on FIRST images: we find several spirals and interacting galaxies and a few E/S0s with very weak, marginally extended radio cores. The only double-lobed (previously known) radio source is a dumbbell. For the rest of the objects, all hosting small and weak radio sources, the DSS is inadequate to determine morphological types. Thus a significant increase in sample size will be a major effort.

Various studies of low-redshift, radio-emitting, early-type galaxies found that the major axis of the radio source shows only a weak preference, if any, to be oriented perpendicular to the optical major axis (e.g. [2]). This is very much in contrast to the powerful high-redshift radio galaxies which tend to have their radio and optical major axes aligned [4]. However, the finding [1] that the radio-optical difference angles of brightest ellipticals in rich, low-z clusters is *bimodal* (with a narrow peak at 0° and a broad one at 90°), seems to support a possible evolutionary link between powerful high-z galaxies and dominant galaxies in clusters.

As the size of the low-z samples is still limited, we searched for more isolated, unperturbed, E/S0 galaxies with extended radio sources, comparing the 96 May 28 version of the FIRST radio catalogue [8] with the APM catalogue [3] of optical objects detected on the Palomar Sky Survey. To allow a safe determination of both morphological type and optical major axis of the galaxies, we limit the APM objects to m_{APM} <17 mag in both R and O. We consider all radio sources with deconvolved size >3″, including those flagged as possible sidelobes, as they will hardly coincide with a bright E/S0 galaxy by chance.

To allow for those extended radio sources appearing as two or more nearby components in the FIRST catalogue we also included multiple sources, i.e. those located within a circle of 70″. APM counterparts were searched within 10″ of isolated radio sources and within 20″ of each of the components of a multiplet. We

also searched a radius of 20″ around the geometric centre of doubles to include any optical object up to 10″ from the line joining a radio pair up to 70″ wide.

To test our selection criteria to find objects suitable to study the radio-optical orientation of E/S0s, we compared APM and FIRST for POSS plate E/O 1342, covering α,δ(J2000)= [8:45...9:15; +32°14′...+38°25′]. Including both extended and multiple radio sources, we found 35 APM objects fulfilling the above criteria.

Knowing the problems in fitting complex multiple objects in both the APM and FIRST catalogues we visually inspected the DSS and FIRST images. On DSS we found 5 multiple objects (blended into one extended APM object), 7 spiral-like objects, 2 interacting ones, and 3 too faint to classify or disturbed. For the remaining 18 objects, seemingly adequate for our purposes judging from DSS, we searched NED. This revealed 3 spirals and 7 IR-emitting objects. The latter are most likely to be of starburst or late type. This confirms that a morphological classification on DSS for m$\gtrsim$15 objects is mere guesswork and that POSS *plates* or *prints* are required to derive the optical type more reliably. DSS2 scans happened to be available for this region, but proved to be equally insufficient for this task.

As a by-product we 'rediscovered' two of Arp's peculiar galaxies. For Arp 195, a chain of 3 galaxies, FIRST shows the central and southern one to be radio emitters. Arp 202 (NGC 2179) shows very diffuse radio emission, apparently not reported before. The only well-extended, double-lobed radio galaxy we found was B2 0908+37, but as it is identified with a dumbbell galaxy [5], it is equally useless for our original aim. Only for three of the E/S0s we found redshifts. Their radio power is near $\log P_{1.4}$(W/Hz)=21.5, i.e. similar to E/S0s discussed in [6].

Our comparison of APM and FIRST over 1 POSS plate yielded about three candidate radio E/S0s, albeit with small and faint radio sources. Not having inspected plates or prints, it is difficult to extrapolate our eventual success rate. Anticipating 3 such objects per POSS plate we may expect to find extended radio sources in up to ∼500 E/S0s when FIRST will have reached its design goal of mapping 10^4 sq. degrees. With only a single object per plate and no continuation of FIRST we may still expect up to ∼100 objects, adequate to improve studies of the optical axiality of E/S0s from their radio axes [7]. Our method also appears well-suited to extend the radio luminosity function of E/S0s to lower luminosities and to find many more radio-weak, IR-emitting late type galaxies. The latter will be useful to study e.g. the faint end of the radio-IR correlation.

We thank R.L. White for the FIRST map server, and the `SkyView` and NED teams for their service. H.A. obtained a travel grant from the conference organizers.

References

1. Andernach H., West M.J., Kotanyi C., Unewisse A.M. 1993, ASP Conf. Ser. 51, 123; eds. G. Chincarini et al.
2. Andernach H. 1995, ASP Conf. Ser. 86, 69; eds. A. Buzzoni, A. Renzini & A. Serrano
3. Lewis G., Irwin M. 1996, Spectrum, RGO Newsletter, 12, 22
4. McCarthy P.J. 1993, ARA&A 31, 369
5. Parma P., Cameron R.A., de Ruiter H.R. 1991, AJ 102, 1960
6. Sadler E.M., Jenkins C.R. & Kotanyi C.G. 1989, MNRAS 240, 591
7. Sansom A.E., Danziger I.J., Ekers R.D., Fosbury R.A.E. et al. 1987, MNRAS 229, 15
8. White R.L., Becker R.H., Helfand D.J., Gregg M.D. 1997, ApJ 475, 479